



Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

## TFT LCD Approval Specification

### **MODEL NO.: V470H2 – LH4**

Customer: Nexgen

Approved by: \_\_\_\_\_

Note:

Approved By	TV Product Marketing & Management Div	
	Chao-Chun Chung	

Reviewed By	QA Dept.	Product Development Div.
	Hsin-nan Chen	WT Lin

Prepared By	LCD TV Marketing and Product Management Div.	
	CY Chang	TC Chao



## CONTENTS

REVISION HISTORY.....	4
1. GENERAL DESCRIPTION.....	5
1.1 OVERVIEW.....	5
1.2 FEATURES.....	5
1.3 APPLICATION .....	5
1.4 GENERAL SPECIFICATIONS .....	5
1.5 MECHANICAL SPECIFICATION .....	6
2. ABSOLUTE MAXIMUM RATINGS .....	7
2.1 ABSOLUTE RATINGS OF ENVIRONMENT.....	7
2.2 PACKAGE STORAGE.....	8
2.3 ELECTRICAL ABSOLUTE RATINGS .....	8
2.3.1 TFT LCD MODULE .....	8
2.3.2 BACKLIGHT INVERTER UNIT .....	8
3. ELECTRICAL CHARACTERISTICS .....	9
3.1 TFT LCD MODULE .....	9
3.2 BACKLIGHT UNIT.....	11
3.2.1 CCFL(Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta=25± 2 °C).....	11
3.2.2 INVERTER CHARACTERISTICS.....	11
3.2.3 INVERTER INTERFACE CHARACTERISTICS .....	13
4. BLOCK DIAGRAM OF INTERFACE .....	15
4.1 TFT LCD MODULE .....	15
DATA DRIVER (RSDS) .....	15
INPUT CONNECTOR.....	15
BACKLIGHT UNIT .....	15
5. INPUT TERMINAL PIN ASSIGNMENT .....	16
5.1 TFT LCD Module Input.....	16
5.2 BACKLIGHT UNIT.....	19
5.3 INVERTER UNIT .....	20
5.4 BLOCK DIAGRAM OF INTERFACE .....	21
5.5 LVDS INTERFACE .....	23



5.6 COLOR DATA INPUT ASSIGNMENT .....	24
6. INTERFACE TIMING .....	25
6.1 INPUT SIGNAL TIMING SPECIFICATIONS .....	25
6.2 POWER ON/OFF SEQUENCE .....	27
7. OPTICAL CHARACTERISTICS .....	28
7.1 TEST CONDITIONS .....	28
7.2 OPTICAL SPECIFICATIONS .....	29
8. PRECAUTIONS .....	32
8.1 ASSEMBLY AND HANDLING PRECAUTIONS .....	32
8.2 SAFETY PRECAUTIONS .....	32
9. DEFINITION OF LABELS .....	33
9.1 CMO MODULE LABEL .....	33
10. PACKAGING .....	35
11. MECHANICAL CHARACTERISTICS .....	37
Appendix – TWO Wire BUS INTRODUCTION .....	40
A.1 PIN ASSIGNMENT .....	40
A.2 I2C BUS APPLICATION NOTE .....	40
A.3 TWO WIRE BUS DEVICE ADDRESS .....	40
A.4 TWO WAY TO CONTROL THE TWO WIRE BUS .....	41
A.5 TWO WIRE BUS COMMAND TABLE .....	42
A.6 TWO WIRE BUS REQUIREMENT .....	44
A.7 THE TWO WIRE BUS SEQUENCE .....	45



Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

## REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver. 1.0	Jun. 01. 2009	All	All	The Preliminary specification was first issued.
Ver. 2.0	Aug. 14. 2009	All	All	The Approval specification was first issued.



## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

V470H2-LH2 is a 47" TFT Liquid Crystal Display module with 12-CCFL Backlight unit and 2ch-LVDS interface.

This module supports 1920 x 1080 Full HDTV format and can display true 1.07G colors (10-bit/color). The inverter module for backlight is built-in.

### 1.2 FEATURES

- High brightness (450 nits)
- High contrast ratio (4000:1)
- Fast response time (Gray to gray average 4.0 ms)
- High color saturation (NTSC 88%)
- Full HDTV (1920 x 1080 pixels) resolution, true HDTV format
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- Optimized response time for 120 Hz frame rate
- Ultra wide viewing angle : Super MVA technology
- RoHS compliance

### 1.3 APPLICATION

- Standard Living Room TVs.
- Public Display Application.
- Home Theater Application.
- MFM Application.

### 1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	1039.68 (H) x584.82 (V) (47" diagonal)	mm	(1)
Bezel Opening Area	1049(H) x 539 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1080	pixel	-
Pixel Pitch(Sub Pixel)	0.5405 (H) x 0.1805 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	1.07G	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	Anti-Glare coating (Haze 11%)/ Hard coating (3H)	-	(2)

Note (1) Please refer to the attached drawings in chapter 9 for more information about the front and back outlines.

Note (2) The spec. of the surface treatment is temporarily for this phase. CMO reserves the rights to change this feature.



Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

## 1.5 MECHANICAL SPECIFICATION

### 1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	-	1096	-	mm	(1), (2)
	Vertical (V)	-	640	-	mm	
	Depth (D)	-	52.7	-	mm	
Weight		-	12500	-	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Module Depth is between bezel to T-CON cover.



## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	+60	°C	(1)
Operating Ambient Temperature	TOP	0	50	°C	(1), (2)
Shock (Non-Operating)	SNOP	X, Y axis	-	50	G (3), (5)
		Z axis		35	G (3), (5)
Vibration (Non-Operating)	VNOP	-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

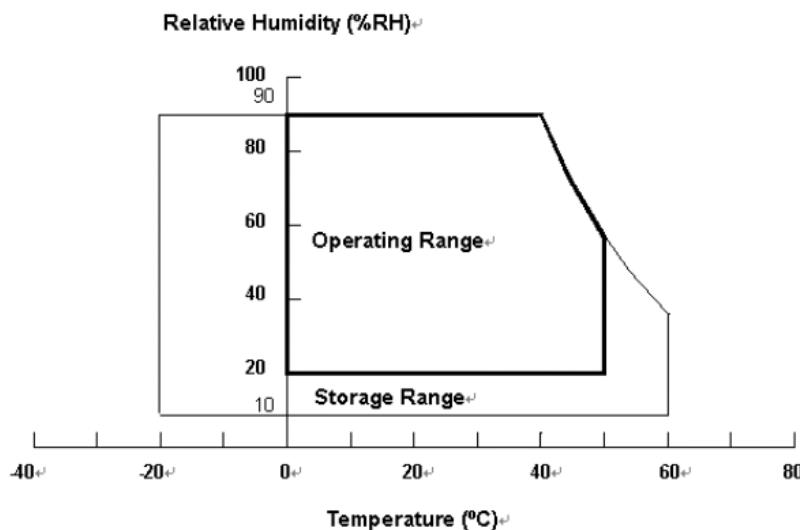
- (a) 90 %RH Max. ( $T_a \leq 40$  °C).
- (b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).
- (c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for  $\pm X, \pm Y, \pm Z$ .

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.





## 2.2 PACKAGE STORAGE

When storing modules as spares for a long time, the following precaution is necessary.

- (a) Do not leave the module in high temperature, and high humidity for a long time, It is highly recommended to store the module with temperature from 0 to 35 °C at normal humidity without condensation.
- (b) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

## 2.3 ELECTRICAL ABSOLUTE RATINGS

### 2.3.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	13.5	V	(1)
Logic Input Voltage	VIN	-0.3	3.6		

### 2.3.2 BACKLIGHT INVERTER UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	VW	—	3000	VRMS	
Power Supply Voltage	VBL	0	30	V	(1)
Control Signal Level	—	-0.3	7	V	(1), (3)

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) No moisture condensation or freezing.

Note (3) The control signals include On/Off Control, Internal PWM Control and External PWM Control.



### 3. ELECTRICAL CHARACTERISTICS

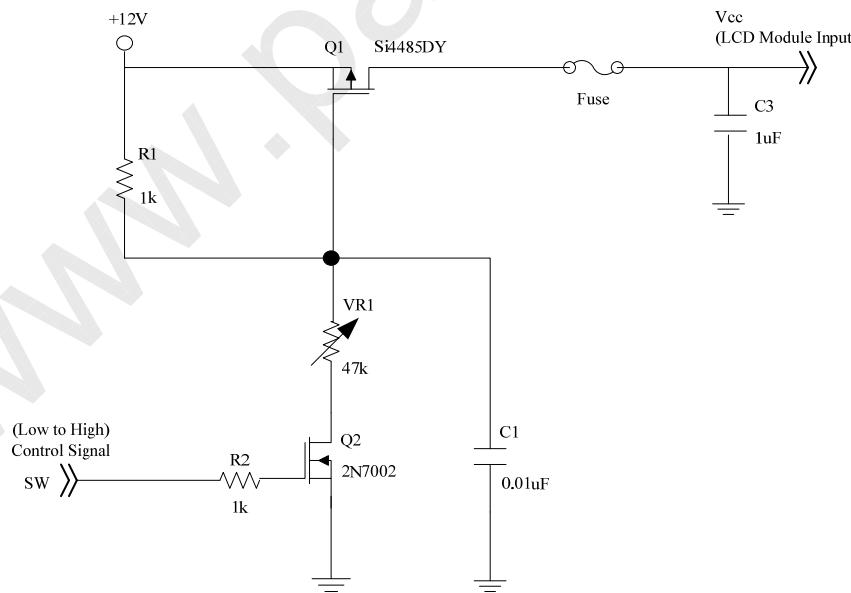
#### 3.1 TFT LCD MODULE

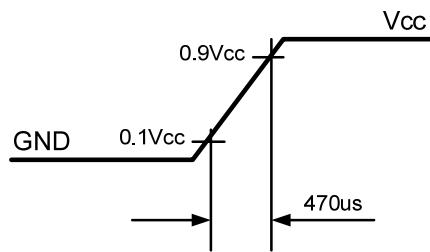
(Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	VCC	10.8	12	13.2	V	(1)
Power Supply Ripple Voltage	VRP	-	-	350	mV	
Rush Current	IRUSH	-	-	5.0	A	(2)
Power Supply Current	White Pattern	-	-	1.6	A	(3)
	Vertical Stripe	-	-	2.3	2.8	
	Black Pattern	-	-	1.6	-	
LVDS interface	Common Input Voltage	VLVC	1.125	1.25	1.375	V
	Terminating Resistor	RT	-	100	-	ohm
CMOS interface	Input High Threshold Voltage	VIH	2.7	-	3.3	V
	Input Low Threshold Voltage	VIL	0	-	0.7	V

Note (1) The module should be always operated within the above ranges.

Note (2) Measurement condition:



**Vcc rising time is 470us**


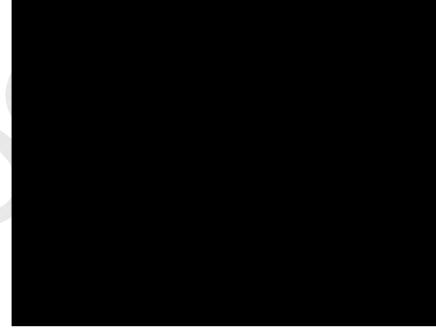
Note (3) The specified power supply current is under the conditions at  $V_{cc} = 12$  V,  $T_a = 25 \pm 2$  °C,  $f_v = 120$  Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



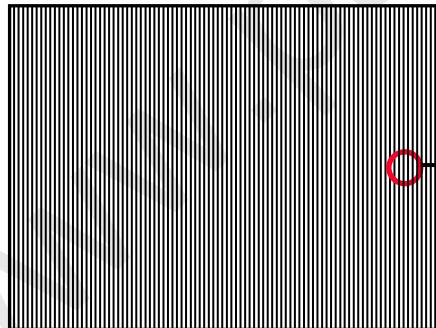
Active Area

b. Black Pattern

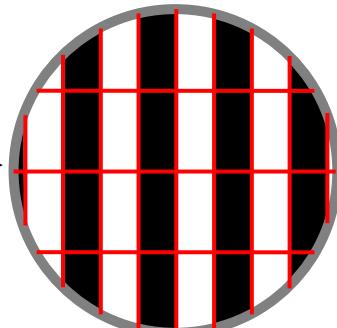


Active Area

c. Vertical Stripe Pattern



Active Area





### 3.2 BACKLIGHT UNIT

#### 3.2.1 CCFL(Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta=25± 2 °C)

(Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	VL	-	1175	-	VRMS	-
Lamp Current	IL	11.0	11.5	12.0	mARMS	(1)
Lamp Turn On Voltage	VS	-	-	1820	VRMS	Ta = 0 °C
		-	-	1620	VRMS	Ta = 25 °C
Operating Frequency	FL	40	-	70	KHz	
Lamp Life Time	LBL	50,000		-	Hrs	(2)

#### 3.2.2 INVERTER CHARACTERISTICS

(Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Consumption	P <sub>BL</sub>	-	163.2	168	W	(5), (6), IL =11.5mA
Power Supply Voltage	VBL	22.8	24.0	25.2	VDC	
Power Supply Current	IBL	-	5.4	-	A	Non Dimming
Input Ripple Noise	-	-	-	912	mVP-P	VBL=22.8V
Oscillating Frequency	FW	37	40	43	kHz	
Dimming Frequency	FB	150	160	170	Hz	
Minimum Duty Ratio	DMIN	-	20	-	%	

Note (1) Lamp current is measured by utilizing AC current probe.

Note (2) The lamp starting voltage V<sub>S</sub> should be applied to the lamp for more than 1 second after startup.

Otherwise the lamp may not be turned on.

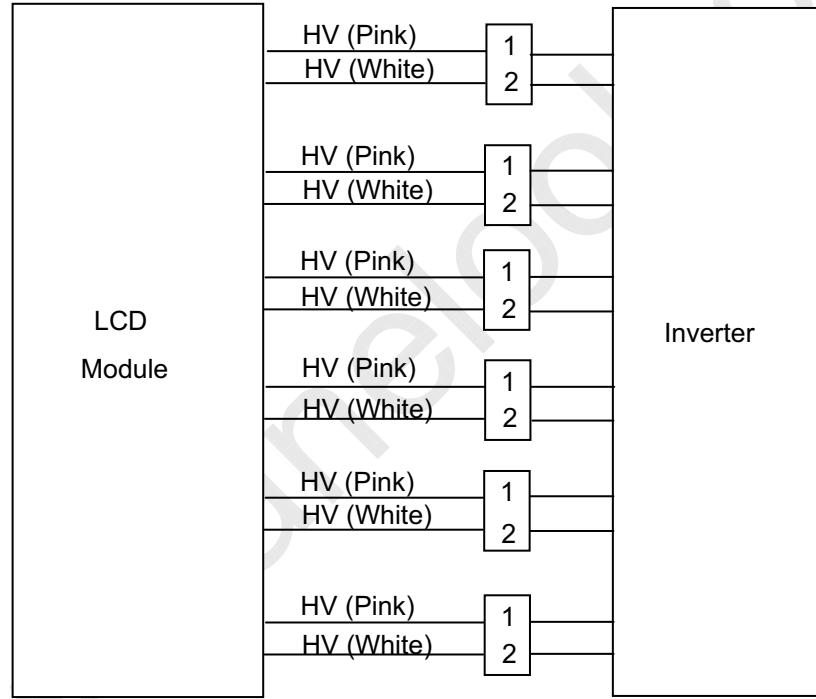
Note (3) The lamp frequency may produce interference with horizontal synchronous frequency of the display input signals, and it may result in line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) The life time of a lamp is defined as when the brightness is larger than 50% of its original value and the effective discharge length is longer than 80% of its original length (Effective discharge length is defined as an area that has equal to or more than 70% brightness compared to the brightness at

the center point of lamp.) as the time in which it continues to operate under the condition at  $T_a = 25 \pm 2^\circ\text{C}$  and  $I_L = 11.0 \sim 12.0 \text{mA rms}$ .

Note (5) The power supply capacity should be higher than the total inverter power consumption  $P_{BL}$ . Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when inverter dimming.

Note (6) The measurement condition of Max. value is based on 47" backlight unit under input voltage 24V, average lamp current 11.8 mA and lighting 30 minutes later.





## 3.2.3 INVERTER INTERFACE CHARACTERISTICS

Parameter	Symbol	Test Condition	Value			Unit	Note
			Min.	Typ.	Max.		
On/Off Control Voltage	VBLON	ON	—	2.0	—	5.0	V
		OFF	—	0	—	0.8	V
Internal PWM Control Voltage	VIPWM	MAX	—	2.85	3.0	3.15	V
		MIN	—	—	0	—	V
External PWM Control Voltage	VEPWM	HI	—	2.0	—	5.0	V
		LO	—	0	—	0.8	V
Status Signal	Status	HI	—	3.0	3.3	3.6	V
		LO	—	0	—	0.8	V
VBL Rising Time	Tr1	—	30	—	—	ms	10%-90%V <sub>BL</sub>
VBL Falling Time	Tf1	—	30	—	—	ms	
Control Signal Rising Time	Tr	—	—	—	100	ms	
Control Signal Falling Time	Tf	—	—	—	100	ms	
PWM Signal Rising Time	TPWMR	—	—	—	50	us	
PWM Signal Falling Time	TPWMF	—	—	—	50	us	
Input Impedance	Rin	—	1	—	—	MΩ	
PWM Delay Time	TPWM	—	100	—	—	ms	
BLON Delay Time	T <sub>on</sub>	—	300	—	—	ms	
	T <sub>on1</sub>	—	300	—	—	ms	
BLON Off Time	Toff	—	300	—	—	ms	

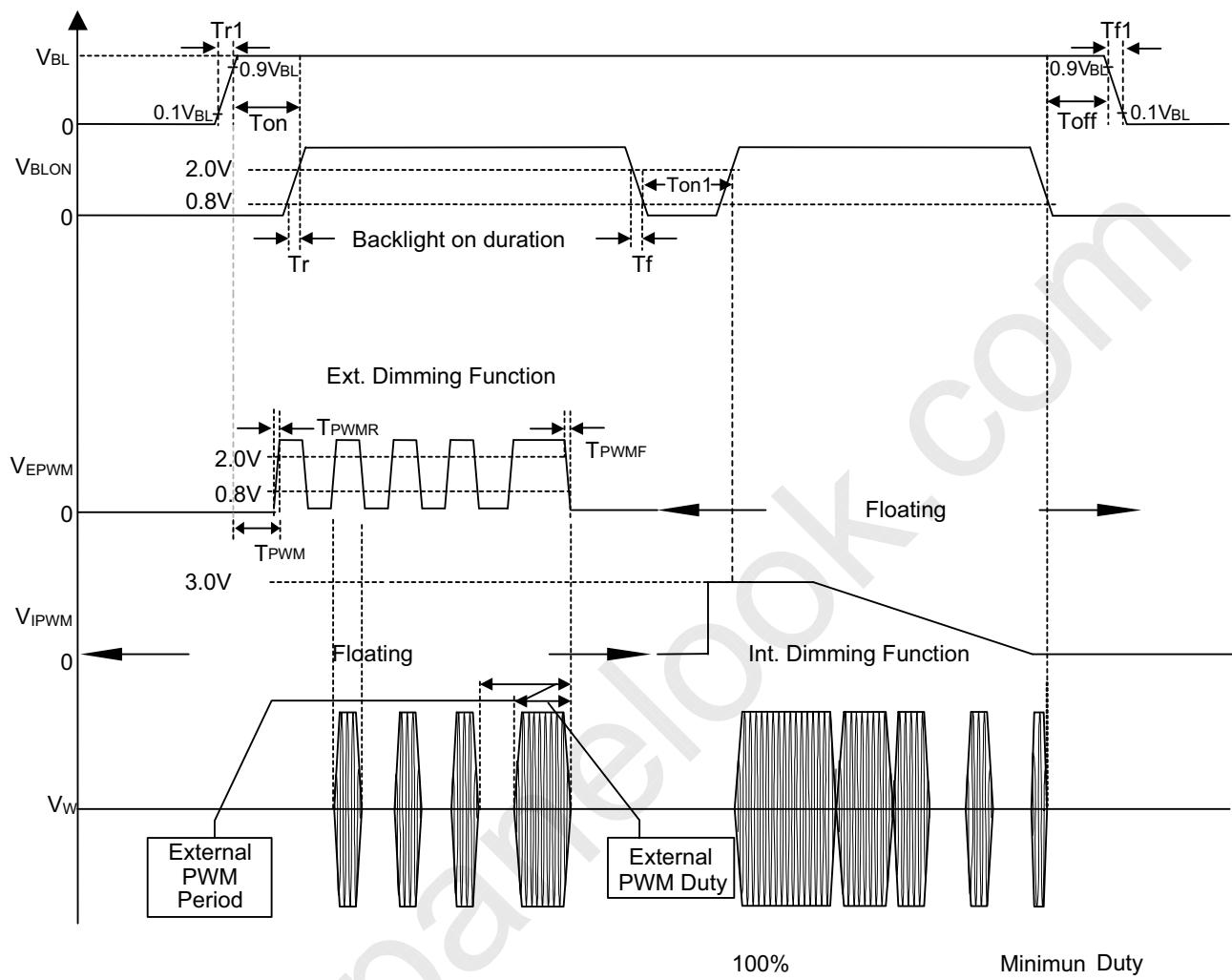
Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the following figure. For a certain reason, the inverter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

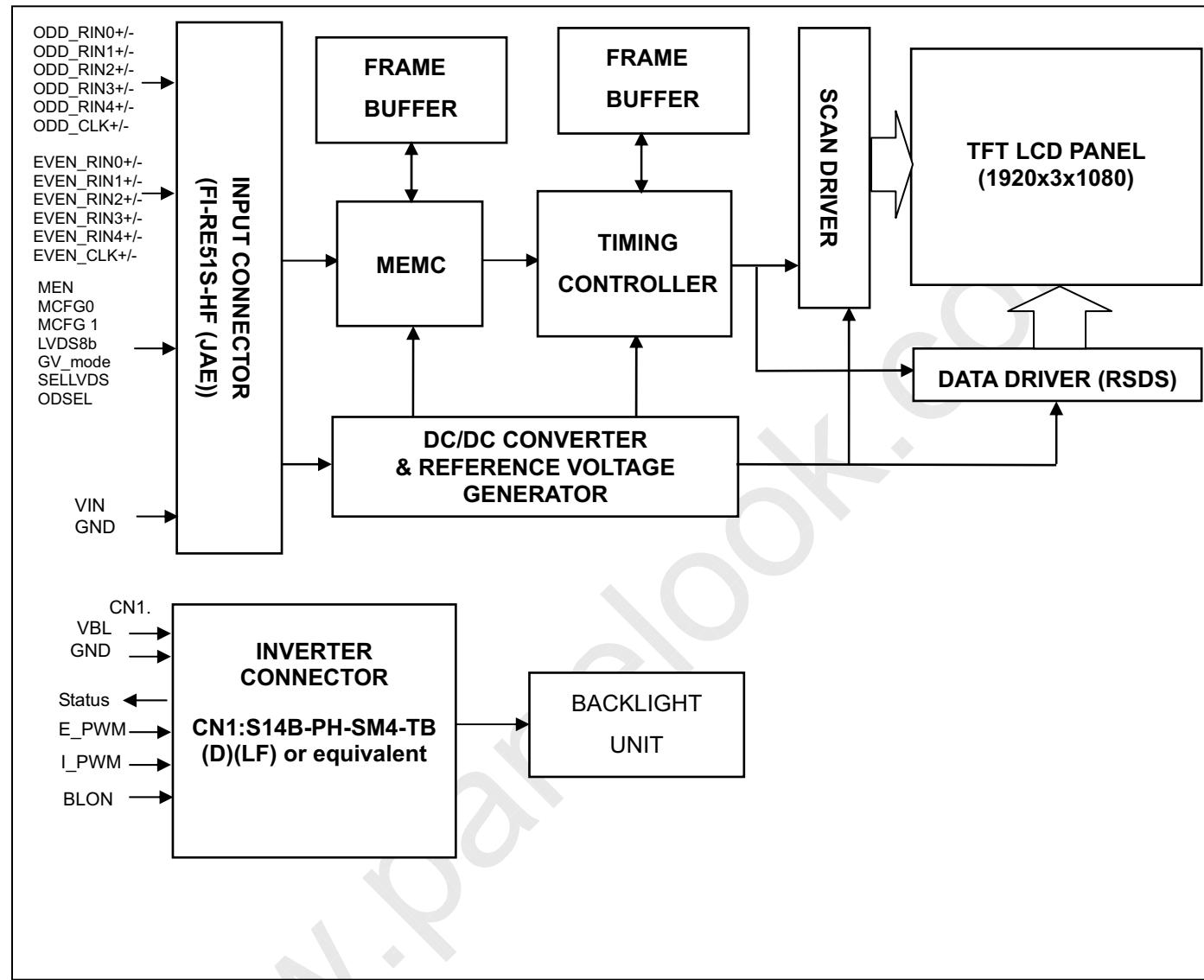
Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL



## 4. BLOCK DIAGRAM OF INTERFACE

### 4.1 TFT LCD MODULE





## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD Module Input

CNF1 Connector Part No.: JAE Taiwan (台灣航空電子) FI-RE51S-HF or equal.

Pin	Name	Description	Note
1	GND	Ground	
2	MEN	MEMC function selection	4
3	MCFG0	MEMC function selection	4
4	MCFG1	MEMC function selection	4
5	LVDS8b	8bit/10bit LVDS input selection	5
6	GV_mode	Graphic / Video mode selection	6
7	SELLVDS	LVDS data format Selection	2
8	CON_SCL	MEMC I2C bus SCL	
9	CON_SDA	MEMC I2C bus SDA	
10	ODSEL	Overdrive Lookup Table Selection	3
11	GND	Ground	
12	ERX0-	2nd pixel Negative LVDS differential data input. Channel 0	
13	ERX0+	2nd pixel Positive LVDS differential data input. Channel 0	
14	ERX1-	2nd pixel Negative LVDS differential data input. Channel 1	
15	ERX1+	2nd pixel Positive LVDS differential data input. Channel 1	
16	ERX2-	2nd pixel Negative LVDS differential data input. Channel 2	
17	ERX2+	2nd pixel Positive LVDS differential data input. Channel 2	
18	GND	Ground	
19	ECLK-	2nd pixel Negative LVDS differential clock input.	
20	ECLK+	2nd pixel Positive LVDS differential clock input.	
21	GND	Ground	
22	ERX3-	2nd pixel Negative LVDS differential data input. Channel 3	
23	ERX3+	2nd pixel Positive LVDS differential data input. Channel 3	
24	ERX4-	2nd pixel Negative LVDS differential data input. Channel 4	
25	ERX4+	2nd pixel Positive LVDS differential data input. Channel 4	
26	N.C.	No Connection	1
27	N.C.	No Connection	1
28	ORX0-	1st pixel Negative LVDS differential data input. Channel 0	
29	ORX0+	1st pixel Positive LVDS differential data input. Channel 0	
30	ORX1-	1st pixel Negative LVDS differential data input. Channel 1	
31	ORX1+	1st pixel Positive LVDS differential data input. Channel 1	
32	ORX2-	1st pixel Negative LVDS differential data input. Channel 2	
33	ORX2+	1st pixel Positive LVDS differential data input. Channel 2	
34	GND	Ground	
35	OCLK-	1st pixel Negative LVDS differential clock input.	
36	OCLK+	1st pixel Positive LVDS differential clock input.	
37	GND	Ground	
38	ORX3-	1st pixel Negative LVDS differential data input. Channel 3	



Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

39	ORX3+	1st pixel Positive LVDS differential data input. Channel 3	
40	ORX4-	1st pixel Negative LVDS differential data input. Channel 4	
41	ORX4+	1st pixel Positive LVDS differential data input. Channel 4	
42	N.C.	No Connection	1
43	DEMO	Demo window enable	7
44	GND	Ground	
45	GND	Ground	
46	GND	Ground	
47	N.C.	No Connection	1
48	VCC	+12V power supply	
49	VCC	+12V power supply	
50	VCC	+12V power supply	
51	VCC	+12V power supply	

Note (1) Reserved for internal use. Please leave it open.

Note (2)

SELLVDS	Mode
L(default)	VESA
H	JEIDA

L: Connect to GND, H: Connect to +3.3V

Note (3) Overdrive lookup table selection. The overdrive lookup table should be selected in accordance with the frame rate to optimize image quality.

ODSEL	Description
L(default)	Lookup table was optimized for 60 Hz frame rate input.
H	Lookup table was optimized for 50 Hz frame rate input.

L: Connect to GND, H: Connect to +3.3V

Note (4) Motion Engine (ME) Level & Demo Function Table

Motion engine level must be adjusted after video mode is selected (or entered).

Adjusting the motion engine level in graphic mode has no effect

		MEN	MCFG1	MCFG0	Notes		
Blanking	Blanking disable	0	0	0	(a)		
	Auto blanking	0	0	1	(b)		
	Blanking enable	0	1	0	(c)		
			Effect of ME →		De blur	De judder	Halo
Demo mode (d)		0	1	1	Demo Window		
ME Level	Strong	1	0	0	Enable	Strong	Strong
	Medium(Default)	1	0	1	Enable	Normal	Normal
	Weak	1	1	0	Enable	×	×
	OFF	1	1	1	×	×	×
	(e) (f) (g)						



- (a) Module re-starts processing video signals from Frontend scaler control board.
- (b) During sync unstable period such as format change, 60Hz <-> 50Hz .  
MCFG0 can be used to insert blanking of 500ms. This signal is toggled.
- (c) Module continues to insert blanking until blanking disable signal is received from frontend scaler board.
- (d) Demo window mode: Demo Window appears to the left half of display area. Left side with frame is 120Hz with MEMC, and right side is 120Hz w/o motion compensation.
- (e) GPIO (General Purpose I/O) sequence of ME Level: (1) MEN; (2) MCFG1; (3) MCFG0.  
GPIO sequence of Blanking Enable, Blanking Disable and Demo window: (1) MCFG1; (2) MCFG0; (3) MEN.
- (f) Each scaler command must be maintained the same voltage level at least 100ms.
- (g) 0 : Connect to GND, 1 : +3.3V

Note (5) 8bit/10bit LVDS input selection

LVDS8b	Bit depth
H(default)	8bit
L	10bit

L : Connect to GND, H : Connect to +3.3V

Note (6) Graphic / Video mode selection

There is no prohibited time period for switching between Graphic mode and Video mode.

When this switching signal is input, LCD will be reset and will re-start selected mode.

GV_mode	Mode select	MEMC ON/OFF
H(default)	Graphic mode	MEMC OFF
L	Video mode	MEMC ON

L : Connect to GND, H : Connect to +3.3V

Note (7) Demo window enable

Demo Window	
L(default)	disable
H	enable

L : Connect to GND, H : Connect to +3.3V



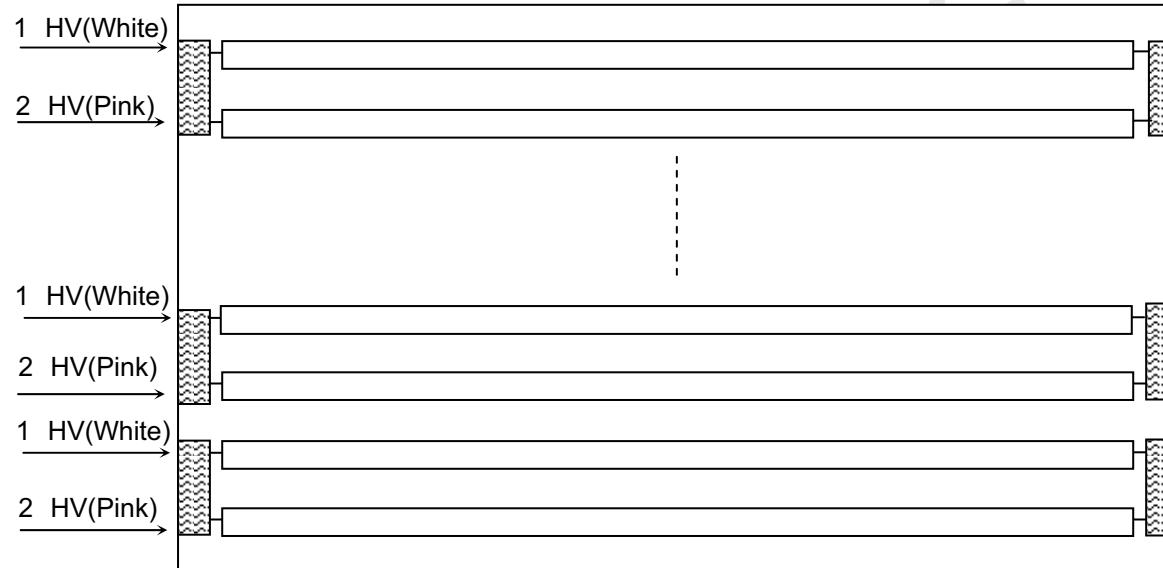
## 5.2 BACKLIGHT UNIT

The pin configuration for the housing and the leader wire is shown in the table below.

CN3~CN26: BHR-04VS-1 (JST).

Pin	Name	Description	Wire Color
1	HV	High Voltage	Pink
2	HV	High Voltage	White

Note (1) The backlight interface housing for high voltage side is a model BHR-04VS-1, manufactured by JST. The mating header on inverter part number is SM02(12.0)B-BHS-1-TB(LF).





### 5.3 INVERTER UNIT

CN1: S14B-PH-SM4-TB(D)(LF)(JST) or equivalent

Pin №	Symbol	Feature
1	VBL	+24V
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	STATUS	Normal (3.3V) Abnormal(GND)
12	E_PWM	External PWM Control Signal
13	I_PWM	Internal PWM Control Signal
14	BLON	BL ON/OFF

Note (1) Pin 12: External PWM control (use pin 12): Pin 13 must open.

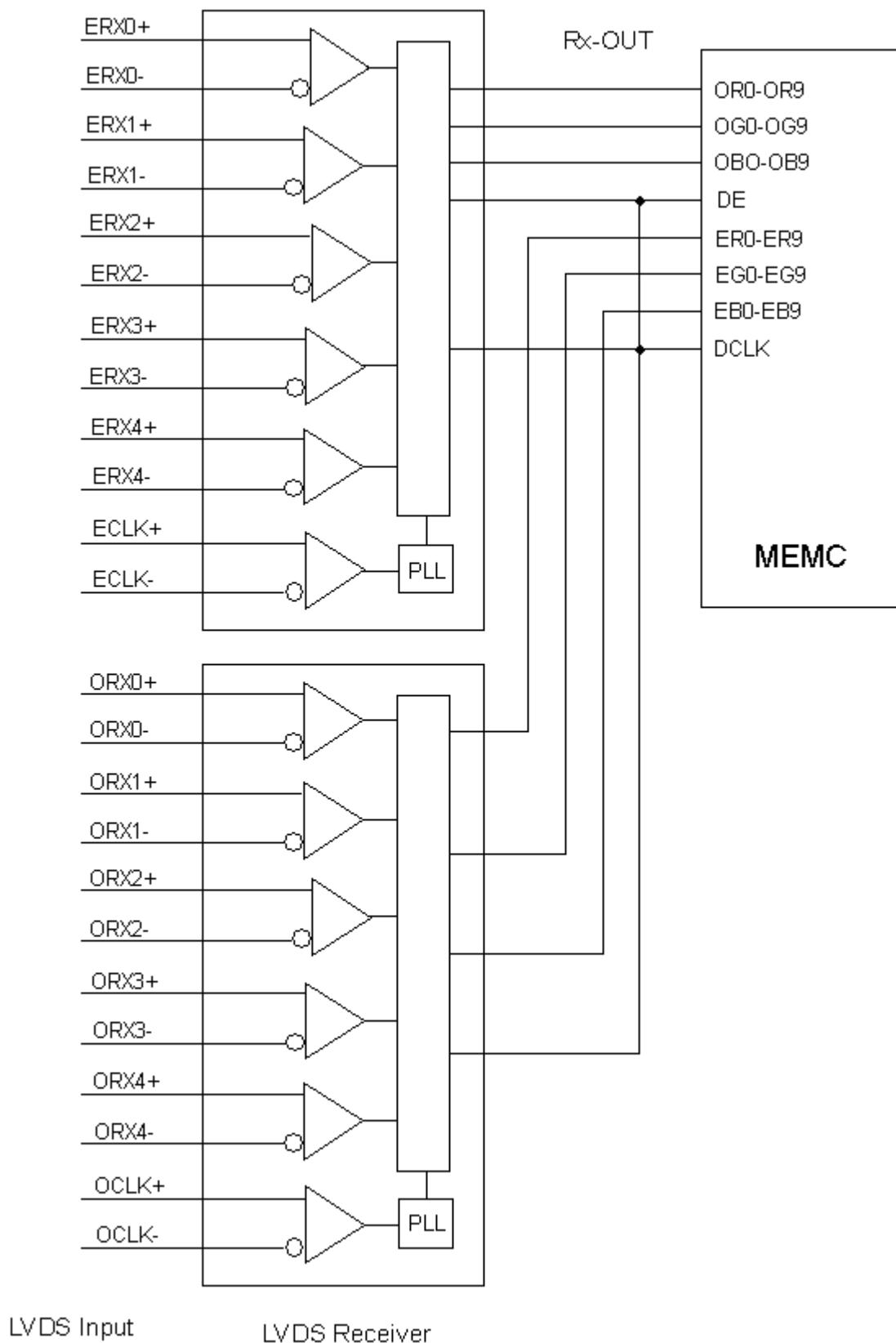
Note (2) Pin 13: Internal PWM control (use pin 13): Pin 12 must open.

Note (3) Pin 12 and Pin 13 can't open in the same period.

CN3~CN26: SM02(12.0)B-BHS-1-TB(LF)(JST) or equivalent

Pin №	Symbol	Description
1	CCFL HOT	CCFL high voltage
2	CCFL HOT	CCFL high voltage

#### 5.4 BLOCK DIAGRAM OF INTERFACE





AR0~AR9: First pixel R data  
AG0~AG9: First pixel G data  
AB0~AB9: First pixel B data  
BR0~BR9: Second pixel R data  
BG0~BG9: Second pixel G data  
BB0~BB9: Second pixel B data  
DE: Data enable signal  
DCLK: Data clock signal

Notes (1) The system must have the transmitter to drive the module.

Notes (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

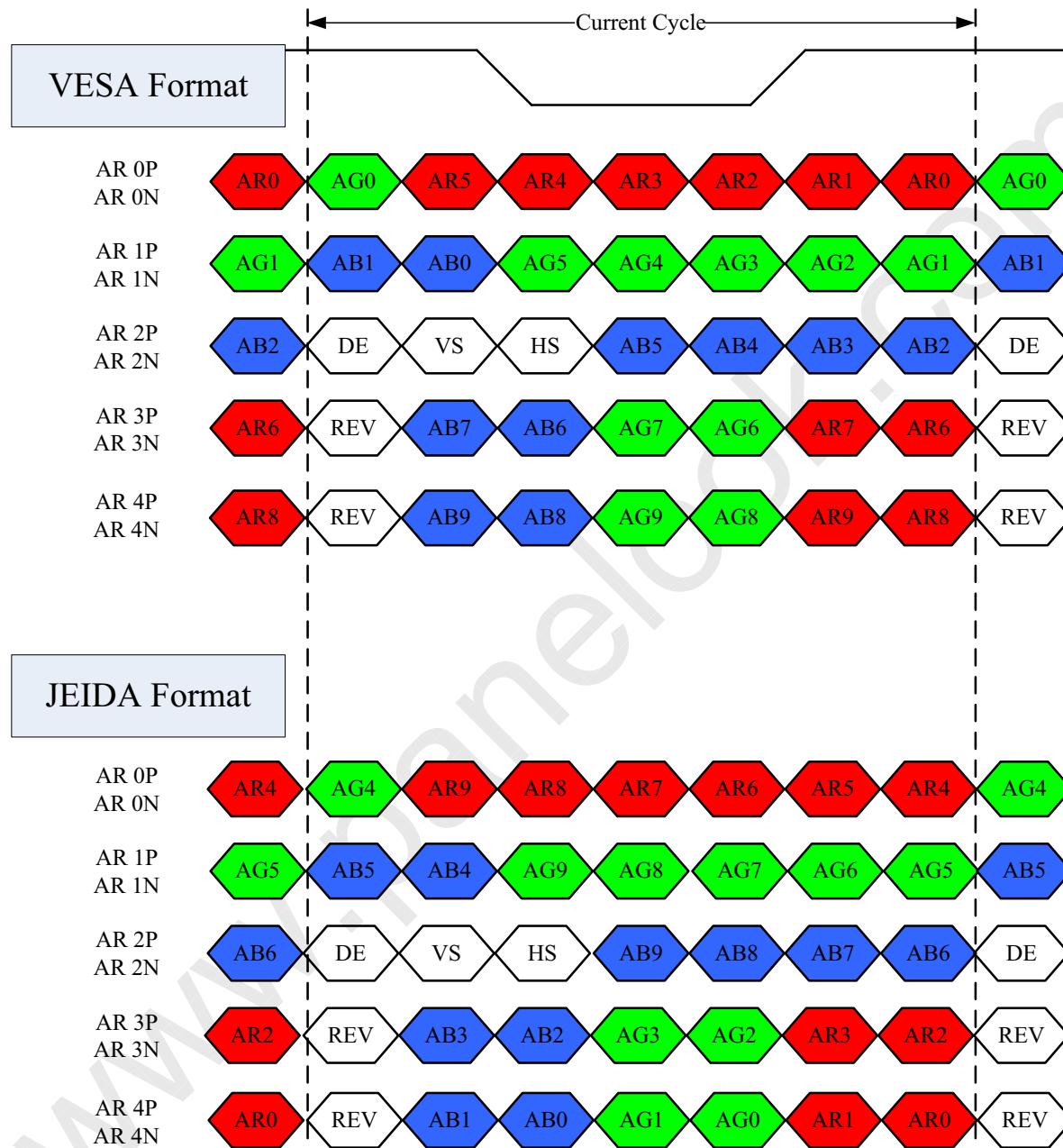
Notes (3) Two pixel data send into the module for every clock cycle. The first pixel of the frame is odd pixel and the second pixel is even pixel.

AR0~AR9: First pixel R data  
AG0~AG9: First pixel G data  
AB0~AB9: First pixel B data

## 5.5 LVDS INTERFACE

VESA Format : SELLVDS = L or Open

JEIDA Format : SELLVDS = H



AR0~AR9: First Pixel R Data (9; MSB, 0; LSB)

AG0~AG9: First Pixel G Data (9; MSB, 0; LSB)

AB0~AB9: First Pixel B Data (9; MSB, 0; LSB)

DE : Data enable signal

DCLK : Data clock signal

RSVD : Reserved



## 5.6 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

Color		Data Signal																													
		Red										Green										Blue									
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cyan	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Magenta	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gray Scale Of Red	Red (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red (1)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red (2)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Red (1021)	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Green (1021)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green (1022)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Green (1023)	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gray Scale Of Blue	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	Blue (1021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1
	Blue (1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 6. INTERFACE TIMING

### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

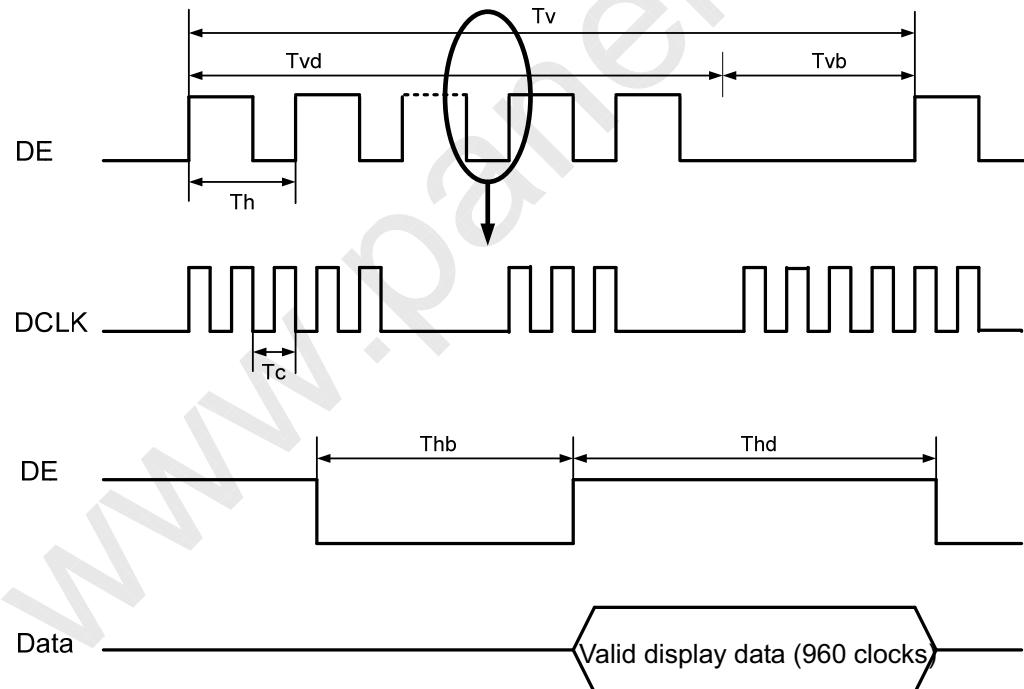
(Ta = 25 ± 2 °C)

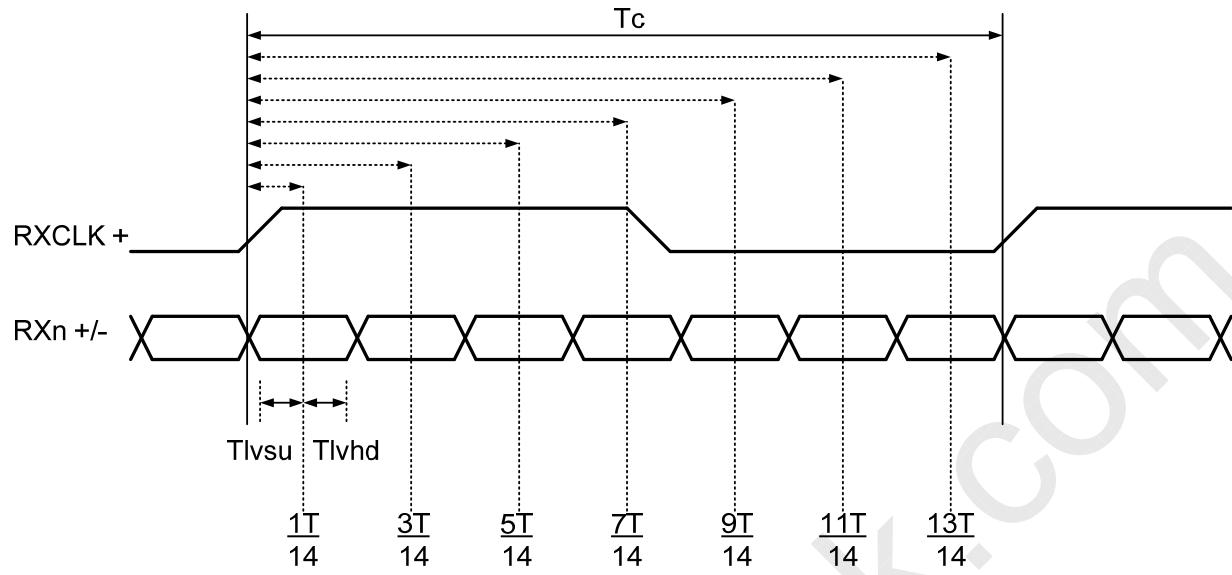
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	1/Tc	60	74.25	78	MHz	-
	Input cycle to cycle jitter	Trcl	-	-	200	ps	-
LVDS Receiver Data	Setup Time	Tlvsu	600	-	-	ps	-
	Hold Time	Tlvhd	600	-	-	ps	-
Vertical Active Display Term	Frame Rate		57	60	61	Hz	-
			47	50	53		-
	Total	Tv	1115	1125	1135	Th	Tv=Tvd+Tvb
	Display	Tvd	1080	1080	1080	Th	-
Horizontal Active Display Term	Blank	Tvb	35	45	55	Th	-
	Total	Th	1050	1100	1150	Tc	Th=Thd+Thb
	Display	Thd	960	960	960	Tc	-
	Blank	Thb	90	140	190	Tc	-

Note : Since the module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

### INPUT SIGNAL TIMING DIAGRAM

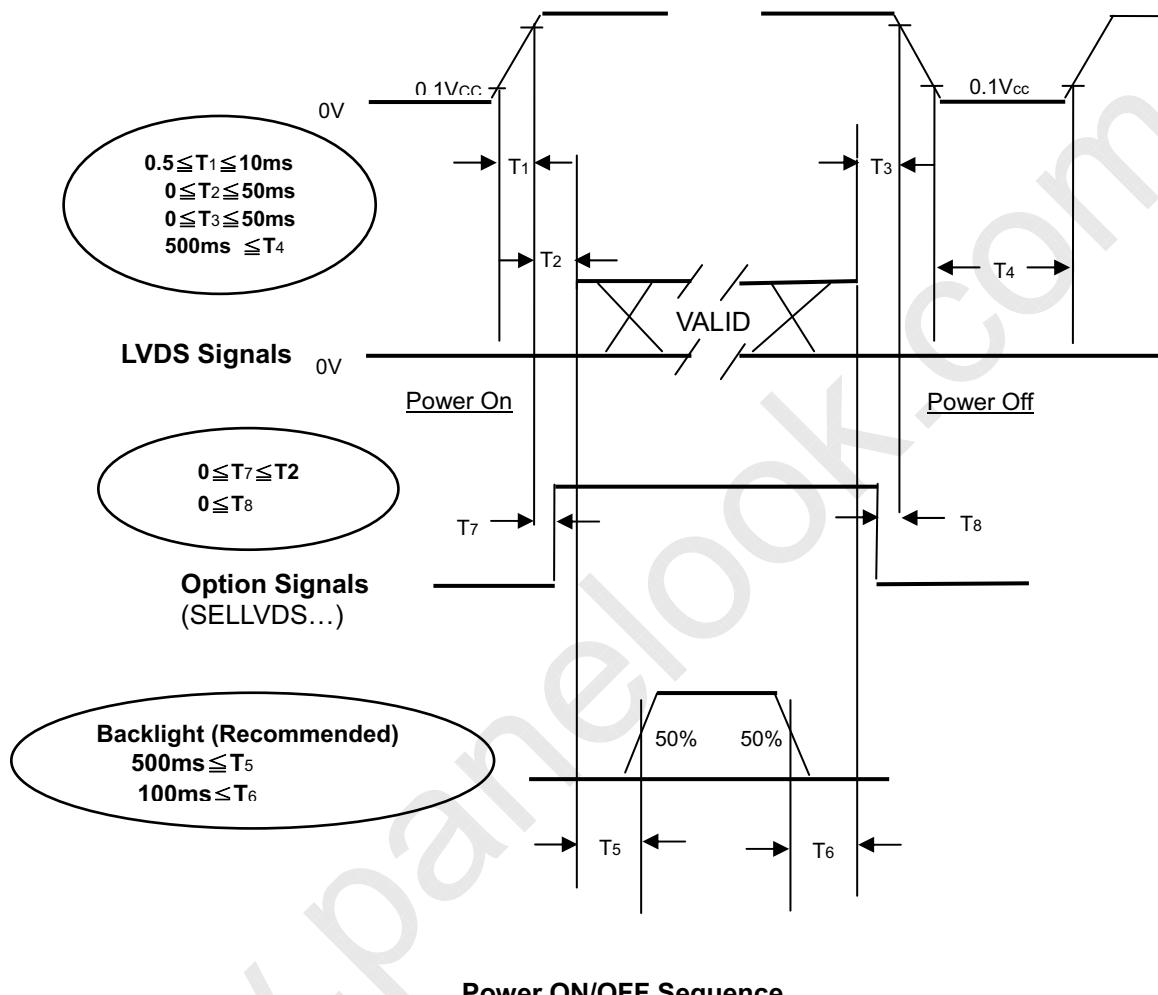


**LVDS INPUT INTERFACE TIMING DIAGRAM**

## 6.2 POWER ON/OFF SEQUENCE

(Ta = 25 ± 2 °C)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should follow the diagram below.



Note.

- (1) The supply voltage of the external system for the module input should follow the definition of Vcc.
- (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.
- (3) In case of VCC is in off level, please keep the level of input signals on the low or high impedance. If T2<0, that maybe cause electrical overstress failures.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

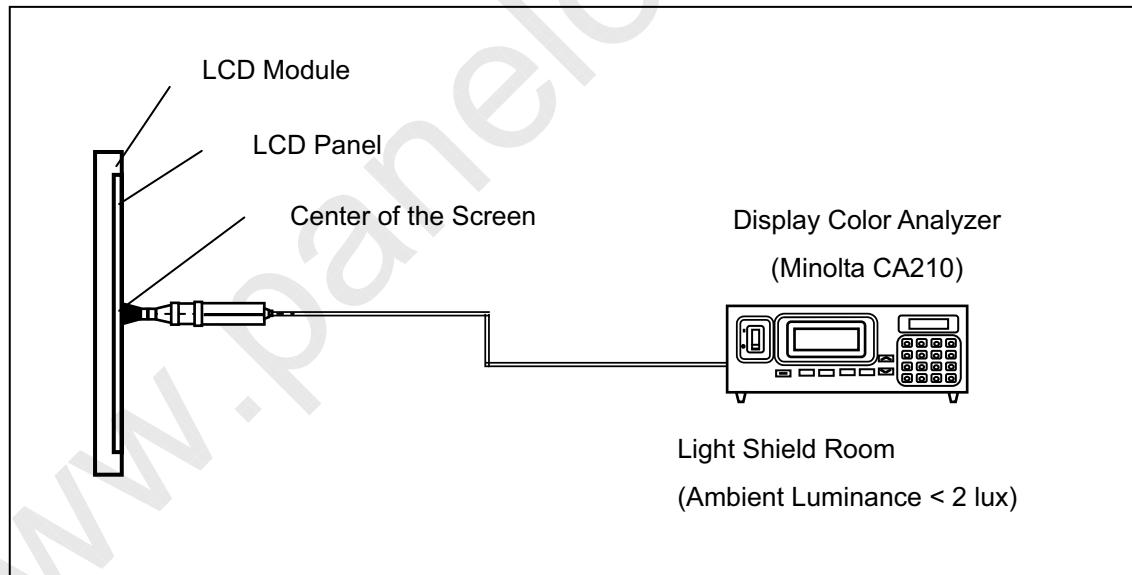


## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	T <sub>a</sub>	25±2	°C
Ambient Humidity	H <sub>a</sub>	50±10	%RH
Supply Voltage	V <sub>CC</sub>	12	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Lamp Current	I <sub>L</sub>	11.5±0.5	mA
Oscillating Frequency (Inverter)	F <sub>W</sub>	40±3	KHz
Vertical Frame Rate	F <sub>r</sub>	120	Hz

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.





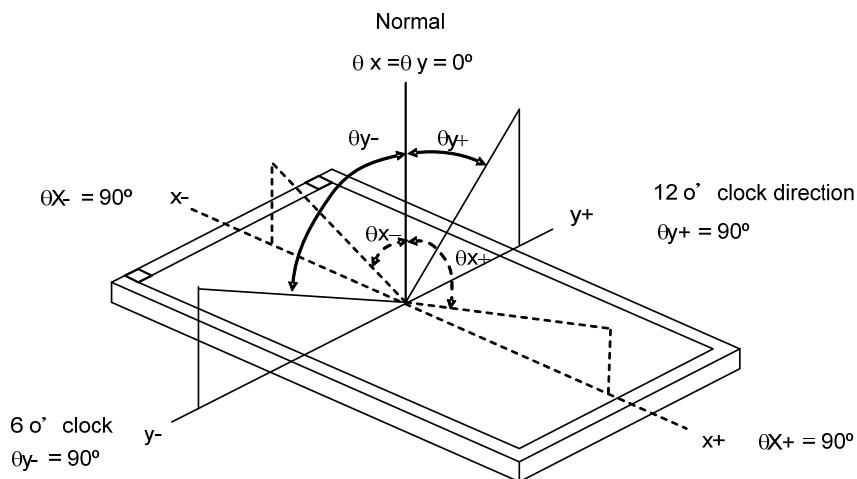
## 7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio	CR	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	3000	4000	-	-	Note (2)
Response Time	Gray to gray		-	4.0	-	ms	Note (3)
Center Luminance of White	LC		350	450	-	cd/m <sup>2</sup>	Note (4)
White Variation	$\delta W$		-	-	1.3	-	Note (7)
Cross Talk	CT		-	-	4	%	Note (5)
Color Chromaticity	Red	Rx	Typ. -0.03	0.643	Typ. +0.03	-	-
		Ry		0.332		-	
	Green	Gx		0.272		-	
		Gy		0.599		-	
	Blue	Bx		0.152		-	
		By		0.067		-	
	White	Wx		0.285		-	
		Wy		0.293		-	
	Color Gamut	C.G		-	88	-	% NTSC
Viewing Angle	Horizontal	$\theta_x+$	CR $\geq$ 20	80	88	-	Deg. Note (1)
		$\theta_x-$		80	88	-	
	Vertical	$\theta_Y+$		80	88	-	
		$\theta_Y-$		80	88	-	

Note (1) Definition of Viewing Angle ( $\theta_x, \theta_y$ ):

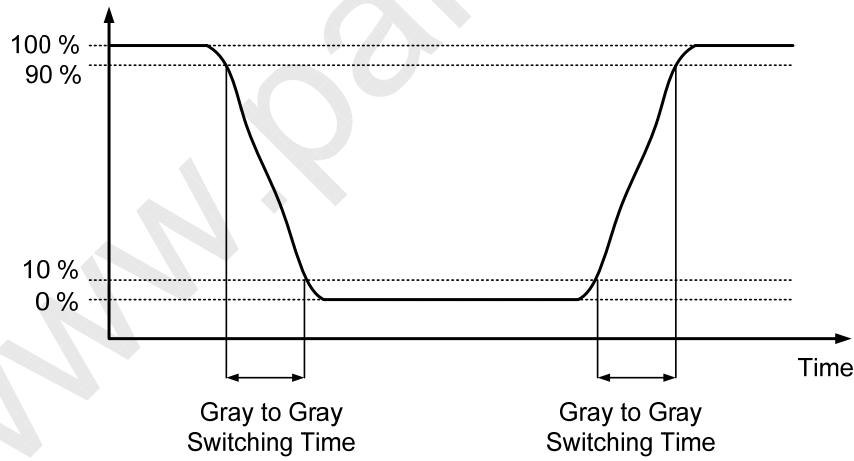
Viewing angles are measured by Eldim EZ-Contrast 160R


**Note (2) Definition of Contrast Ratio (CR):**

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

**Note (3) Definition of Gray-to-Gray Switching Time:**
**Optical Response**


The driving signal means the signal of gray level 0, 252, 508, 764, and 1023. Gray to gray average time means the average switching time of gray level 0, 252, 508, 764, 1023 to each other.

**Note (4) Definition of Luminance of White (LC, LAVE):**

Measure the luminance of gray level 1023 at center point and 5 points

LC = L (5), where L (X) is corresponding to the luminance of the point X at the figure in Note (6).

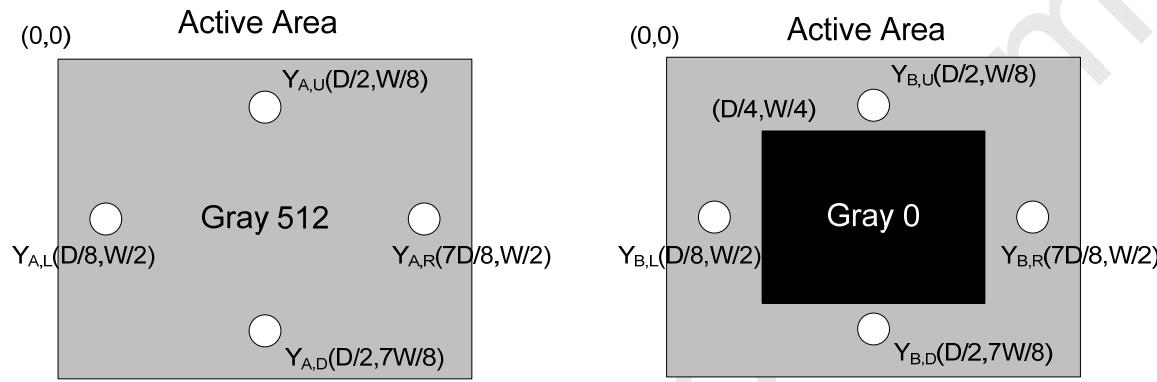
Note (5) Definition of Cross Talk (CT):

$$CT = | Y_B - Y_A | / Y_A \times 100 (\%)$$

Where:

$Y_A$  = Luminance of measured location without gray level 0 pattern ( $cd/m^2$ )

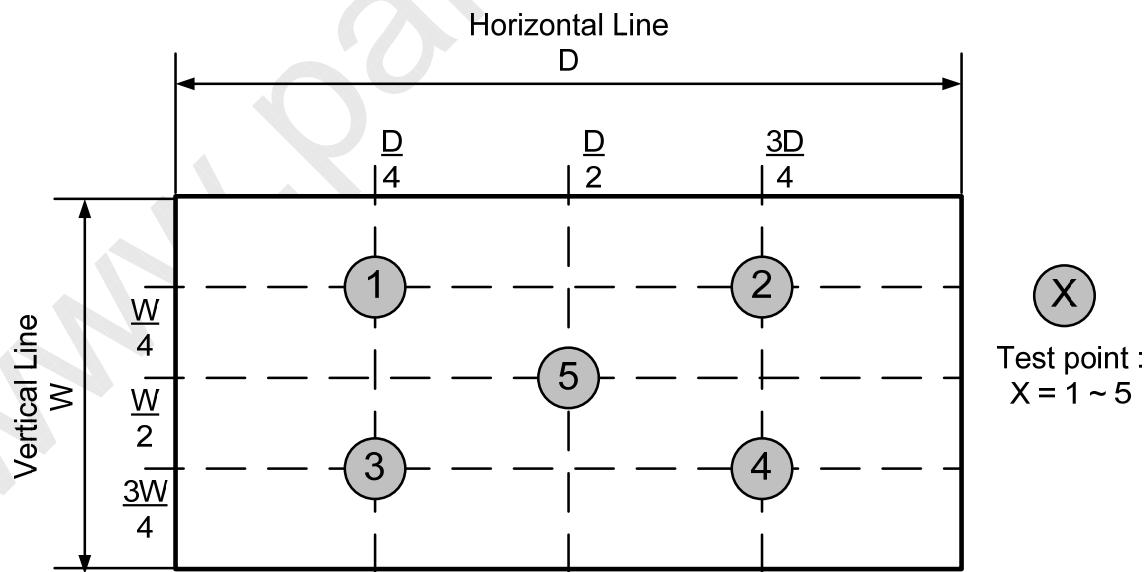
$Y_B$  = Luminance of measured location with gray level 0 pattern ( $cd/m^2$ )



Note (6) Definition of White Variation ( $\delta W$ ):

Measure the luminance of gray level 1023 at 5 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$





## 8. PRECAUTIONS

### 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- [ 1 ] Do not apply rough force such as bending or twisting to the module during assembly.
- [ 2 ] It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- [ 3 ] Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- [ 4 ] Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- [ 5 ] Do not plug in or pull out the I/F connector while the module is in operation.
- [ 6 ] Do not disassemble the module.
- [ 7 ] Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- [ 8 ] Moisture can easily penetrate into LCD module and may cause the damage during operation.
- [ 9 ] When storing modules as spares for a long time, the following precaution is necessary.
  - [ 9.1 ] Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C at normal humidity without condensation.
  - [ 9.2 ] The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.
- [ 10 ] When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

### 8.2 SAFETY PRECAUTIONS

- [ 1 ] The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the Backlight unit.
- [ 2 ] If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- [ 3 ] After the module's end of life, it is not harmful in case of normal operation and storage.



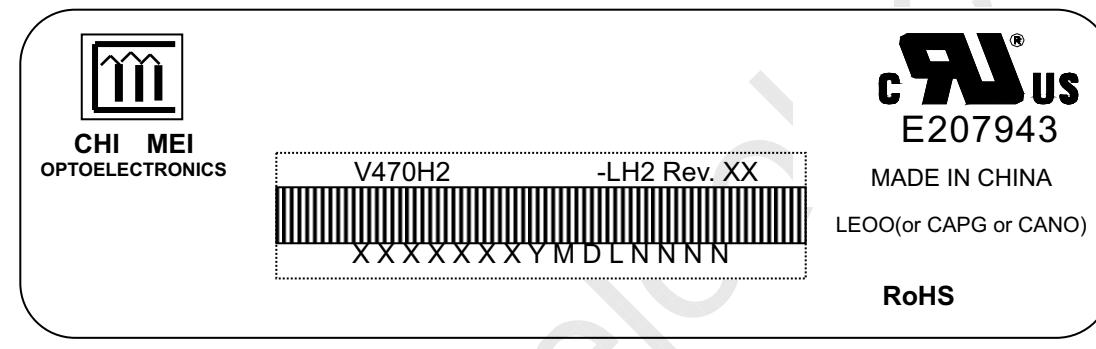
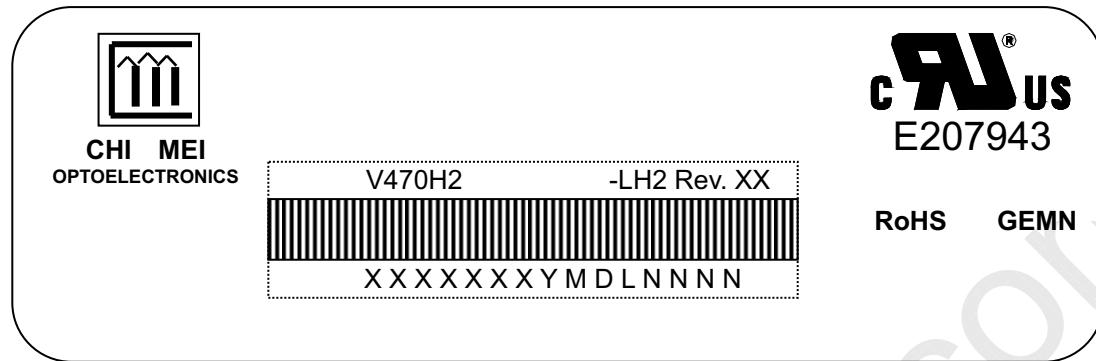
Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

## 9. DEFINITION OF LABELS

### 9.1 CMO MODULE LABEL

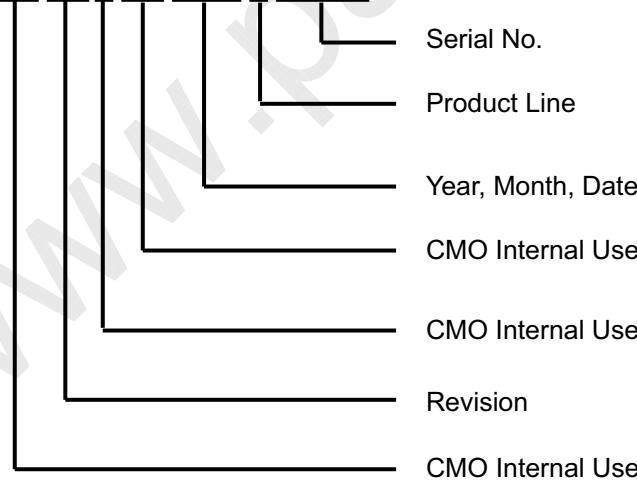
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



Model Name: V470H2-LH2

Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.

Serial ID: X X X X X X X Y M D L N N N N



Serial ID includes the information as below:

Manufactured Date:

Year: 0~9, for 2000~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O, and U.



Issue Date: Aug.14.2009

Model No.: V470H2-LH4

**Approval**

Revision Code: Cover all the change

Serial No.: Manufacturing sequence of product

Product Line: 1 -&gt; Line1, 2 -&gt; Line 2, ...etc.

www.panelook.com



## 10. PACKAGING

### 10.1 PACKING SPECIFICATIONS

- (1) 3 LCD TV modules / 1 Box
- (2) Box dimensions : 1190(L)x280(W)x712(H)mm
- (3) Weight : approximately 42 Kg ( 3 modules per box)

### 10.2 PACKING METHOD

Figures 10-1 and 10-2 are the packing method

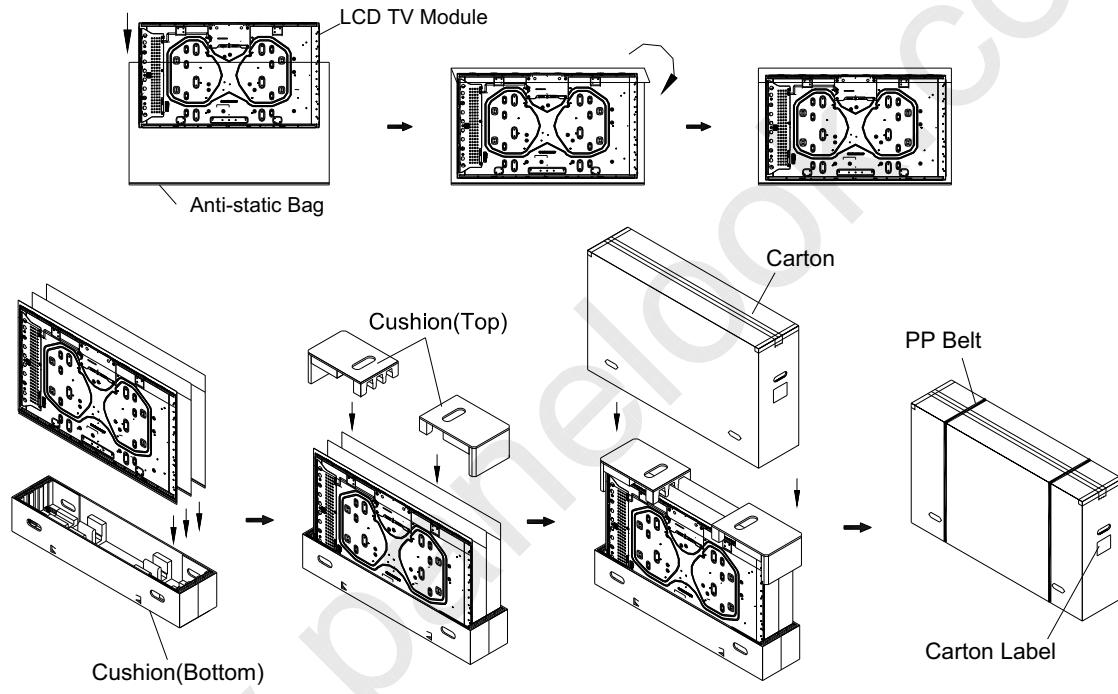
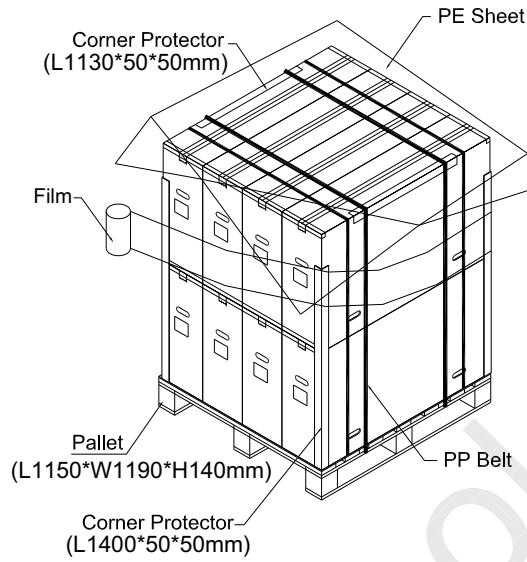
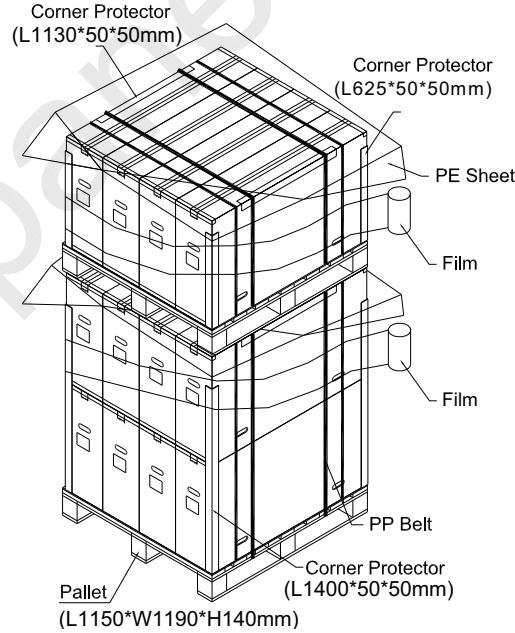


Figure.10-1 packing method

Air Transportation &  
 Sea / Land Transportation (40ft Container)


## Sea / Land Transportation (40ft HQ Container)



Gross: 534kg

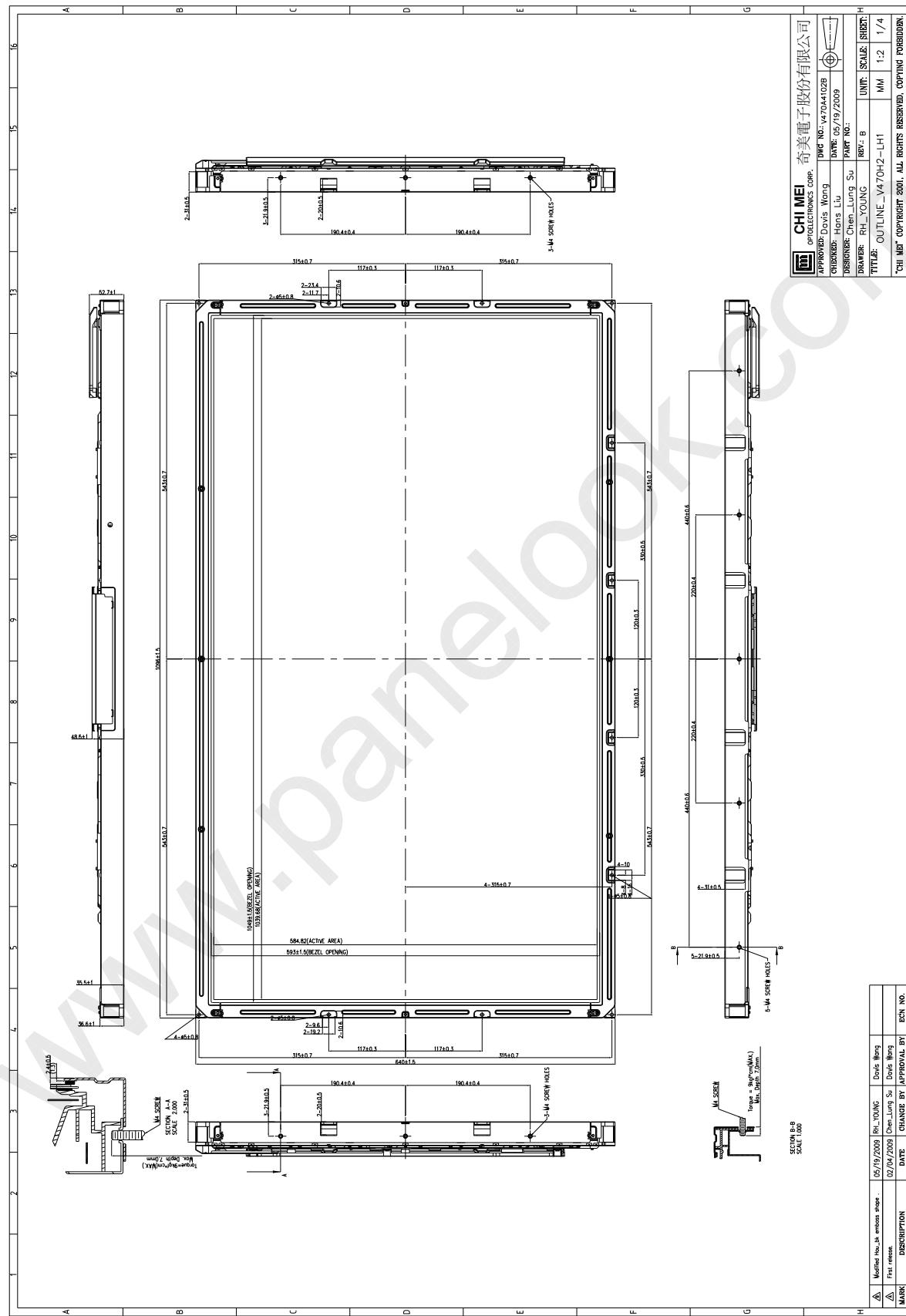
Figure.10-2 packing method

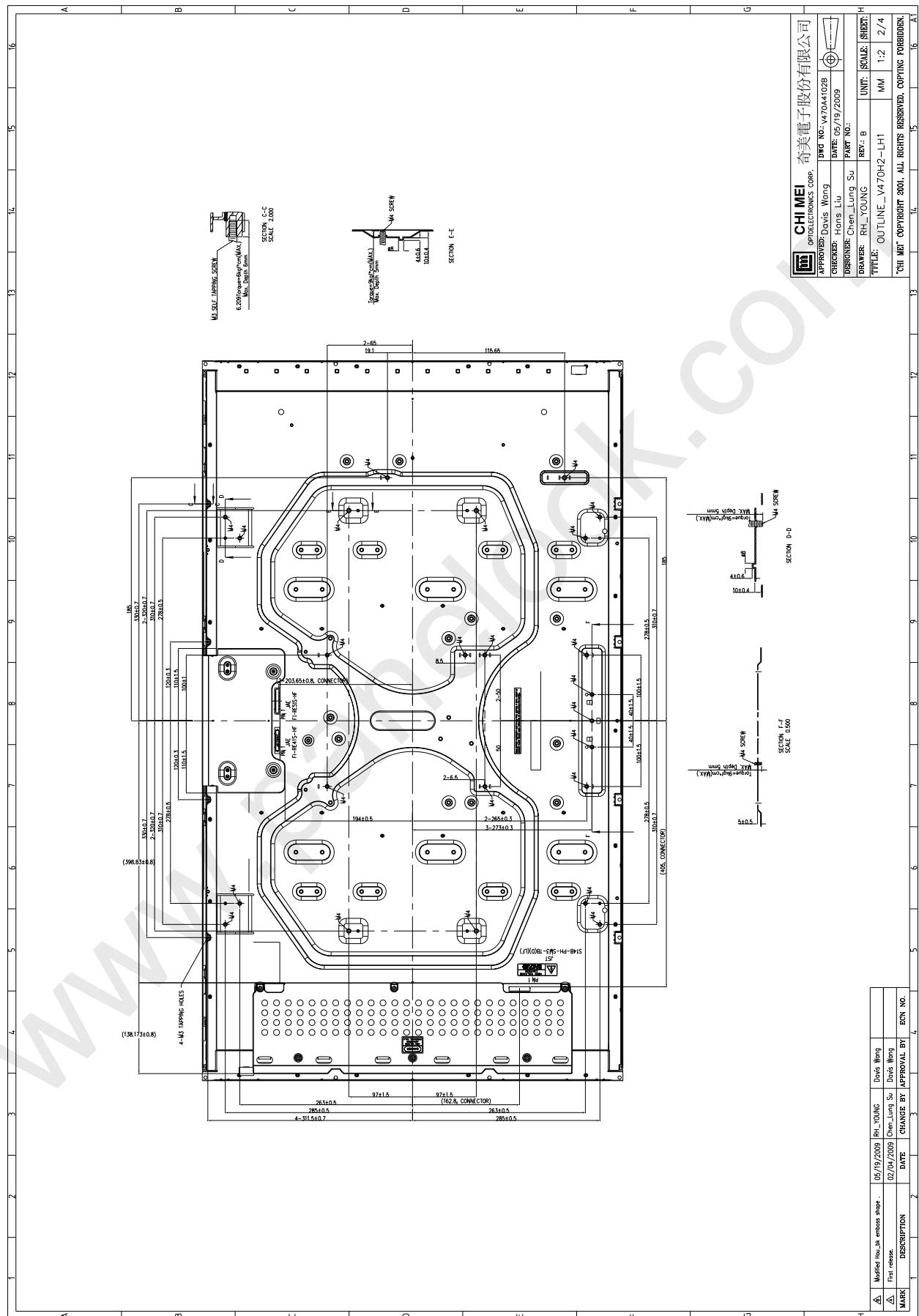


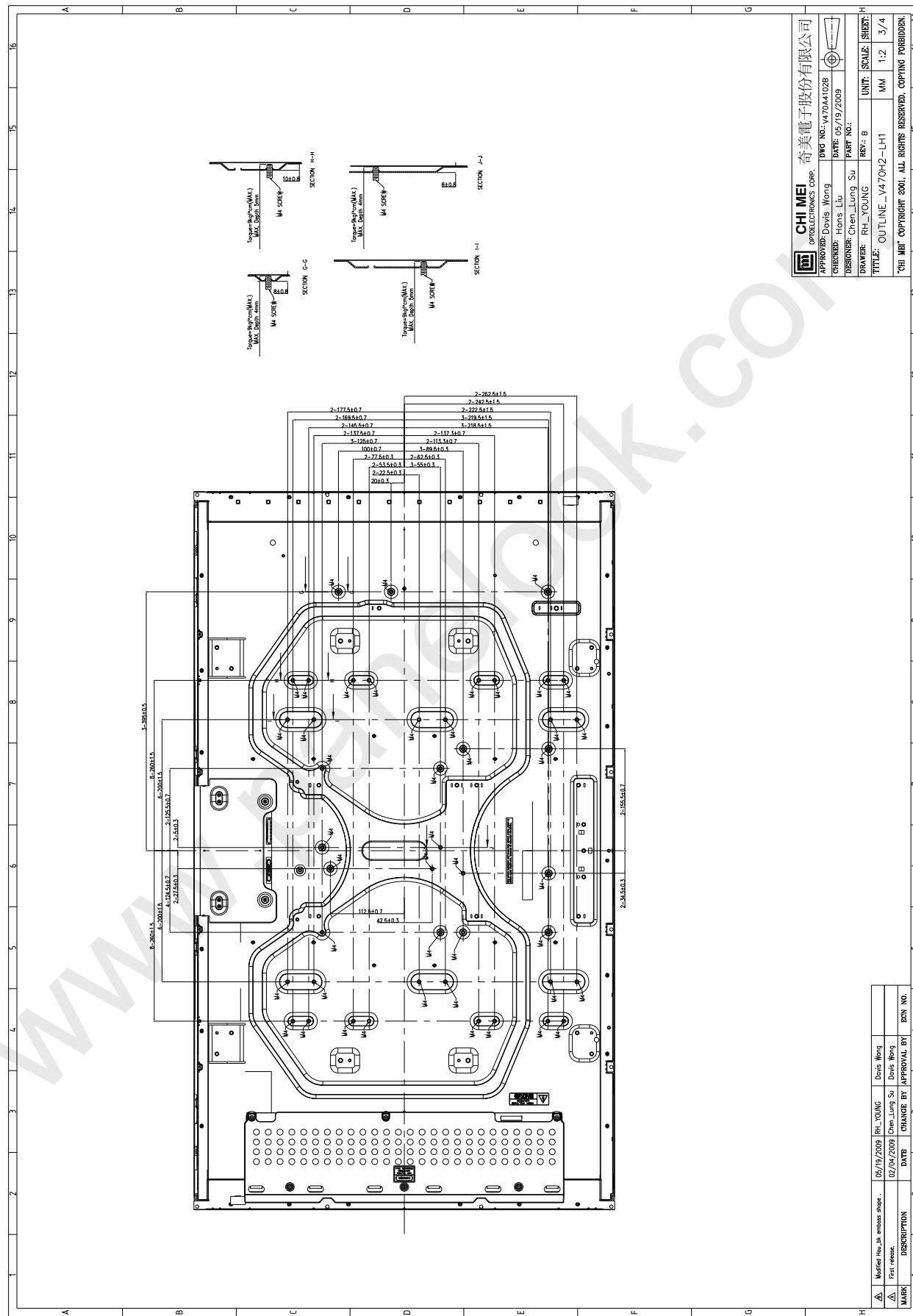
Issue Date: Aug.14.2009  
Model No.: V470H2-LH4

Approval

## 11. MECHANICAL CHARACTERISTICS









## Appendix – TWO Wire BUS INTRODUCTION

### A.1 PIN ASSIGNMENT

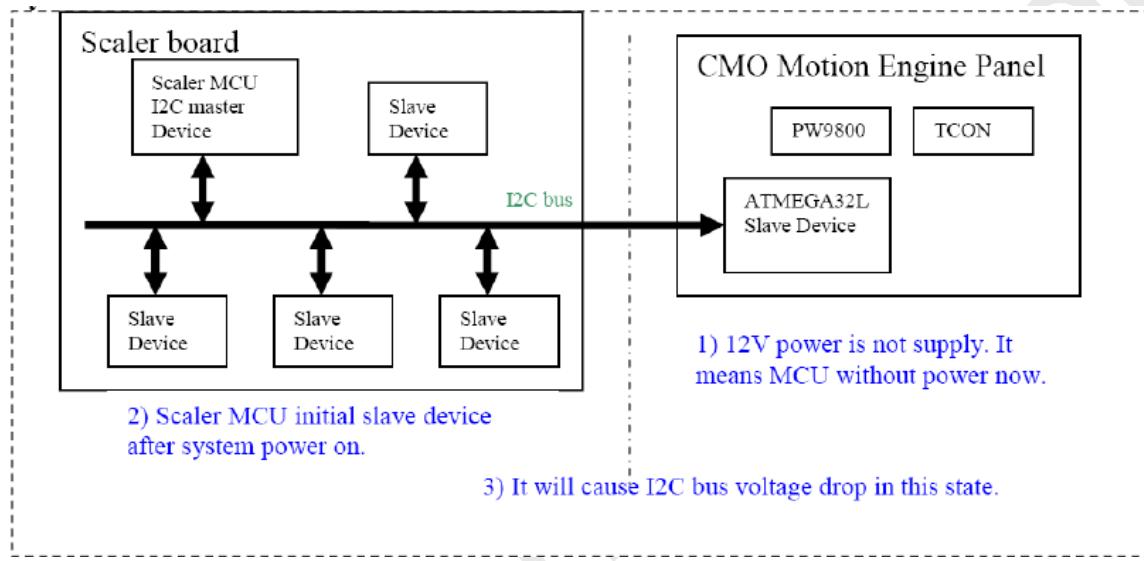
51pins LVDS connector

Pin8: SCL

Pin9: SDA

### A.2 I2C BUS APPLICATION NOTE

I2C bus: (The I2C bus must for MEMC only or prevent the I2C bus voltage drop down in initial state)



### A.3 TWO WIRE BUS DEVICE ADDRESS

Two wire device address: default is 0x40, 1 byte

Two wire command: the range is 0x00 to 0xFF, 1 byte, see the two wire command table.

Two wire bus format:

Device Address : 0x40 default								Command							
D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	0	0	0	W/R	L	x	x	x	x	x	x	x
W/R write : 0; Read : 1															
L 1 : 1Byte Data Length; 0: 4Byte Data Length															
S TWI-Bus Start condition from master															
Sr TWI-Bus Start condition from master															
A TWI-Bus Acknowledge bit from master															
/A TWI-Bus Not Acknowledge bit from slave															
P TWI-Bus Stop condition from master															
Data TWI Bus Data from master								Data TWI Bus Data from slave							



#### A.4 TWO WAY TO CONTROL THE TWO WIRE BUS

There are two options to control the two wires bus command.

##### Two wire bus 6 bytes format

TWI BUS 6 BYTES FORMATE										
Write Operation										
MSB	LSB	MSB	LSB	MSB						LSB
S	Device Addr	0	A	0	Command	A	1st Data	A	2nd Data	A
1bit	8bit	W	1bit	8bit	1bit		1bit	1bit	1bit	1bit
TWI BUS 6 BYTES FORMATE										
Read Operation										
MSB	LSB	MSB	LSB							
S	Device Addr	0	A	0	Command	A				
1bit	8bit	W	1bit	8bit	1bit					
↓	MSB	LSB	MSB							LSB
Sr	Device Addr	1	A	1	1st Data	A	2nd Data	A	3rd Data	A
1bit	8bit	R	1bit	8bit	1bit	8bit	1bit	8bit	1bit	1bit
TWI BUS 6 BYTES FORMATE										
Sr	Device Addr	1	A	1	4th Data	A	/A	P		
1bit	8bit	R	1bit	8bit	1bit	8bit	1bit	1bit		

##### Two wire bus 3 bytes format

TWI BUS 3 BYTES FORMATE									
Write Operation									
MSB	LSB	MSB	LSB	MSB	LSB				
S	Device Addr	0	A	1	Command	A	1st Data	A	P
1bit	8bit	W	1bit	8bit	1bit	8bit	1bit	1bit	1bit
TWI BUS 3 BYTES FORMATE									
Read Operation									
MSB	LSB	MSB	LSB						
S	Device Addr	0	A	1	Command	A			
1bit	8bit	W	1bit	8bit	1bit				
↓	MSB	LSB	MSB						LSB
Sr	Device Addr	1	A	1	1st Data	A	/A	P	
1bit	8bit	R	1bit	8bit	1bit	8bit	1bit		

##### Note:

A transmission basically consists of a START condition, a SLA+R/W, one or more data packets and a STOP condition. An empty message, consisting of a START followed by a STOP condition, is illegal. Note that the wired-ANDing of the SCL line can be used to implement handshaking between the master and the slave. The slave can extend the SCL low period by pulling the SCL line low. This is useful if the clock speed set up by the master is too fast for the slave, or the slave needs extra time for processing between the data transmissions. The slave extending the SCL low period will not affect the SCL high period, which is determined by the master. As a consequence, the slave can reduce the TWI data transfer speed by prolonging the SCL duty cycle.



### A.5 TWO WIRE BUS COMMAND TABLE

There is two wire bus command table.

Command Name	Access Mode	Description	
Demo_Window	0x09	R/W	ME Performance Demo
MEMC_Level	0x0A	R/W	ME Performance
GV_Mode	0x0B	R/W	ME Operation
Blanking	0x0C	R/W	Blinking the screen

Example:

Demo Window

Demo Window : 0x09																	
4 Bytes Data Length																	
1st BYTE DATA	D31	D30	D29	D28	D27	D26	D25	D24	D31~D25								
	Unused					D24	Unused										
2nd BYTE DATA	D23	D22	D21	D20	D19	D18	D17	D16	D24								
	Unused					D23~D0	Demo Window 1 : On ; 0 : Off										
3rd BYTE DATA	D15	D14	D13	D12	D11	D10	D9	D8	D23~D0								
	Unused																
4th BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D23~D0								
	Unused																
Demo Window : 0x89																	
1 Byte Data Length																	
1st BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D7~D1								
	Unused					D0	Unused										
	Unused					D0	Demo Window 1 : On ; 0 : Off										

MEMC Level

ME Level : 0x0A																	
4 Bytes Data Length																	
1st BYTE DATA	D31	D30	D29	D28	D27	D26	D25	D24	D31~D25								
	Unused					D27~D24	Unused										
2nd BYTE DATA	D23	D22	D21	D20	D19	D18	D17	D16	D27~D24								
	Unused						ME Level 0~12										
3rd BYTE DATA	D15	D14	D13	D12	D11	D10	D9	D8	D23~D0								
	Unused						11 : ME Off										
4th BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D23~D0								
	Unused						12 : Reserved										
ME Level : 0x8A																	
1 Byte Data Length																	
1st BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D7~D4								
	Unused					D3~D0	Unused										
	Unused					D3~D0	ME Level 0~12										
	Unused					D3~D0	11 : ME Off										
	Unused					D3~D0	12 : Reserved										



## GV Mode

GV Mode : 0x0B																
4 Bytes Data Length																
1st BYTE DATA	D31	D30	D29	D28	D27	D26	D25	D24	D31~D25	Unused						
	Unused								D24	1 : Graphic ; 0 : Video						
2nd BYTE DATA	D23	D22	D21	D20	D19	D18	D17	D16	D23~D0	Unused						
	Unused															
3rd BYTE DATA	D15	D14	D13	D12	D11	D10	D9	D8								
	Unused															
4th BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0								
	Unused															
GV Mode : 0x8B																
1 Byte Data Length																
1st BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D7~D1	Unused						
	Unused								D0	1 : Graphic ; 0 : Video						

## Blanking (Enable/Disable)

Blanking : 0x0C																
4 Bytes Data Length																
1st BYTE DATA	D31	D30	D29	D28	D27	D26	D25	D24	D31~D25	Unused						
	Unused								D24	1 : On ; 0 : Off						
2nd BYTE DATA	D23	D22	D21	D20	D19	D18	D17	D16	D23~D0	Unused						
	Unused															
3rd BYTE DATA	D15	D14	D13	D12	D11	D10	D9	D8								
	Unused															
4th BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0								
	Unused															
Blanking : 0x8C																
1 Byte Data Length																
1st BYTE DATA	D7	D6	D5	D4	D3	D2	D1	D0	D7~D1	Unused						
	Unused								D0	1 : On ; 0 : Off						

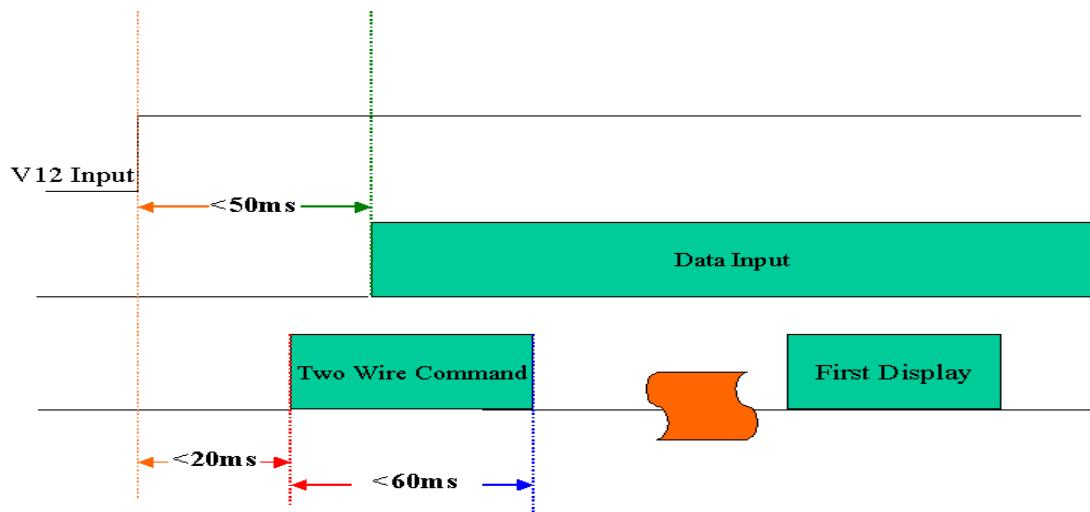


## A.6 TWO WIRE BUS REQUIREMENT

Symbol	Parameter	Condition	Min	Max	Units
$V_L$	Input Low-voltage		-0.5	$0.3V_{CC}$	V
$V_H$	Input High-voltage		$0.7V_{CC}$	$V_{CC} + 0.5$	V
$V_{Hys}^{(1)}$	Hysteresis of Schmitt Trigger Inputs		$0.05V_{CC}^{(2)}$	—	V
$V_{OL}^{(1)}$	Output Low-voltage	3 mA sink current	0	0.4	V
$t_r^{(1)}$	Rise Time for both SDA and SCL		$20 + 0.1C_b^{(3)(2)}$	300	ns
$t_f^{(1)}$	Output Fall Time from $V_{ILmin}$ to $V_{ILmax}$	$10\text{ pF} < C_b < 400\text{ pF}^{(3)}$	$20 + 0.1C_b^{(3)(2)}$	250	ns
$t_{SP}^{(1)}$	Spikes Suppressed by Input Filter		0	$50^{(2)}$	ns
$I_i$	Input Current each I/O Pin	$0.1V_{CC} < V_i < 0.9V_{CC}$	-10	10	$\mu\text{A}$
$C_i^{(1)}$	Capacitance for each I/O Pin		—	10	pF
$f_{SCL}$	SCL Clock Frequency	$f_{CK}^{(4)} > \max(16f_{SCL}, 250\text{kHz})^{(5)}$	0	400	kHz
$R_p$	Value of Pull-up resistor	$f_{SCL} \leq 100\text{ kHz}$	$\frac{V_{CC} - 0.4V}{3\text{mA}}$	$\frac{1000\text{ns}}{C_b}$	$\Omega$
		$f_{SCL} > 100\text{ kHz}$	$\frac{V_{CC} - 0.4V}{3\text{mA}}$	$\frac{300\text{ns}}{C_b}$	$\Omega$
$t_{HD:STA}$	Hold Time (repeated) START Condition	$f_{SCL} \leq 100\text{ kHz}$	4.0	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	0.6	—	$\mu\text{s}$
$t_{LOW}$	Low Period of the SCL Clock	$f_{SCL} \leq 100\text{ kHz}^{(6)}$	4.7	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}^{(7)}$	1.3	—	$\mu\text{s}$
$t_{HIGH}$	High period of the SCL clock	$f_{SCL} \leq 100\text{ kHz}$	4.0	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	0.6	—	$\mu\text{s}$
$t_{SU:STA}$	Set-up time for a repeated START condition	$f_{SCL} \leq 100\text{ kHz}$	4.7	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	0.6	—	$\mu\text{s}$
$t_{HD:DAT}$	Data hold time	$f_{SCL} \leq 100\text{ kHz}$	0	3.45	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	0	0.9	$\mu\text{s}$
$t_{SU:DAT}$	Data setup time	$f_{SCL} \leq 100\text{ kHz}$	250	—	ns
		$f_{SCL} > 100\text{ kHz}$	100	—	ns
$t_{SU:STOP}$	Setup time for STOP condition	$f_{SCL} \leq 100\text{ kHz}$	4.0	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	0.6	—	$\mu\text{s}$
$t_{BUF}$	Bus free time between a STOP and START condition	$f_{SCL} \leq 100\text{ kHz}$	4.7	—	$\mu\text{s}$
		$f_{SCL} > 100\text{ kHz}$	1.3	—	$\mu\text{s}$

### A.7 THE TWO WIRE BUS SEQUENCE

Two Wire command can be initialized during 20ms to 60ms.



Example:

The previous state is strong mode, and the power is reset. The two wire command (strong mode command) must be initialized during 20ms to 60ms.